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Review of Red Sea *Xenisthmus* Snyder (Teleostei: Gobioidei: Xenisthmidae), with description of a new species

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Abstract

Three species of the xenisthmid genus *Xenisthmus* Snyder are recorded from the Red Sea. *Xenisthmus polyzonatus* (Klunzinger), the only described species previously known from the Red Sea, is reported on the basis of eight specimens from Egypt, Eritrea and Saudi Arabia. *Xenisthmus oligoporus* new species is described from four specimens, 17.7–25.0 mm SL, from Sudan and Saudi Arabia. It is distinguished from all other congeners in having a reduced number of cephalic sensory pores and 14–15 segmented rays in the second dorsal fin. *Xenisthmus balius* Gill & Randall is newly recorded from the Red Sea on the basis of 13 specimens from Eritrea, Egypt and Saudi Arabia. The new specimens of this species are described and compared with previously known specimens, the holotype and eight paratypes from the Arabian (= Persian) Gulf. All three species are described in detail and illustrated with colour photographs. An identification key to the species is also provided.

Key words: Arabian Gulf, taxonomy, key to species

Introduction

The genus *Xenisthmus* Snyder (1908) is one of six genera in the Indo-Pacific gobioid family Xenisthmidae (Gill *et al.* 2014). Species of the genus are typically found in sand areas adjacent to rubble or reef. A revision of the genus is currently underway by the first author. At present the genus includes 11 nominal species: *Eleotris polyzonatus* Klunzinger (1871), *Heteroleotris clara* Jordan & Seale (1906), *Xenisthmus proriger* Snyder (1908), *Gignumentum penicillum* Whitley (1933), *Luzoneleotris nasugbua* Herre (1938), *X. africanus* Smith (1958), *Kraemericus chapmani* Schultz (in Schultz *et al.* 1966), *X. balius* Gill & Randall (1994), *X. chi* Gill & Hoese (2004), *X. eirospilus* Gill & Hoese (2004) and *X. semicinctus* Gill & Hoese (2004). To date, a single described species of the genus has been recorded from the Red Sea, *X. polyzonatus* (see Clark 1968, Dor 1984, Golani & Bogorodsky 2010). However, while describing *X. balius* from the Arabian (= Persian) Gulf, Gill & Randall (1994) noted the presence of a similar species from the Red Sea. Recent fieldwork in the Red Sea has yielded additional specimens of the new species, as well as specimens of *X. balius* and *X. polyzonatus*. Further specimens of *X. balius* and *X. polyzonatus* were found among collections made in the Red Sea by V.G. Springer in 1969. We herein provide a review of Red Sea *Xenisthmus*, including a description of the new species, and a key that distinguishes all three species.

Materials and methods

Specimens from the following institutions were examined: American Museum of Natural History, New York (AMNH); Australian Museum, Sydney (AMS); Natural History Museum, London (BMNH); Bernice P. Bishop Museum, Honolulu (BPBM); King Abdulaziz University Marine Museum, Jeddah (KAUMM); Senckenberg Research Institute and Natural History Museum, Frankfurt (SMF); National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM).

Measurements were made with digital calipers, recorded to the nearest 0.1 mm. All measurements to the snout tip were made to the mid-anterior tip of the upper lip. Standard length (SL) was measured from the snout tip to the middle of the caudal-fin base. Predorsal, preanal and prepelvic lengths were measured from the snout tip to the base of the anteriormost spine of the relevant fin. Head length was measured from the snout tip to the dorsal edge of the gill opening. Head width was measured where broadest between the posterior edges of the preopercles. Body width was measured at the pectoral-fin bases. Snout length was measured from the snout tip to the anterior orbital rim. Eye diameter was the horizontal width of the eyeball. Bony interorbital width was the least measurement. "Snout tip to retroarticular tip" is the distance from the snout tip to the posteriormost tip of the retroarticular bone. Caudal-peduncle length was measured from the base of the posteriormost anal-fin ray to the ventral edge of the caudal peduncle at the vertical through the posterior edge of the lower hypural plate. Caudal-peduncle depth was measured obliquely distance between the bases of the posteriormost anal- and dorsal-fin rays. Pectoral-fin base depth was measured as the vertical depth of the fleshy lobe. Pectoral-fin length was the length of the longest ray. Caudal-fin length was the length of the ventralmost ray on the upper hypural plate. Other measurements are self-explanatory.

The last ray in the anal and second-dorsal fins is divided at its base and was counted as a single ray. "Scales in lateral series" was counted from the upper edge of the pectoral-fin base along the mid-side of the body to the posterior edge of the hypural plate. "Scales in forward transverse series" is the number of scales in the transverse series counted anterodorsally from the anal-fin origin. "Scales in backward transverse series" is the number of scales in the transverse series counted posterodorsally from the anal-fin origin. The pattern of interdigititation of first-dorsal-fin proximal pterygiophores between neural spines is given as a dorsal-fin pterygiophore formula following Birdsong *et al.* (1988). Gill-raker counts include all elements on the outer face of the first arch; the angle raker is included in the lower-limb (second) count.

Specimens were temporarily stained with Cyanine Blue 5R to facilitate examination of small structures (Saruwatari *et al.* 1997). Osteological details were determined from x-radiographs or specimens that were cleared and stained for demonstration of cartilage and bone (Taylor & Van Dyke 1985). Letter codes for cephalic sensory pores follow Akihito *et al.* (1984; see also Gill & Randall 1994: fig. 2). Morphometric data are summarised in Table 1. Frequency distributions for selected meristic characters are summarised in Table 2. In the description of the new species, counts are presented first for the holotype, followed, where different, by value ranges or frequency distributions for paratypes. Frequency distributions are presented in the form "x fy", where "x" is the count and "f" indicates that the following value, "y", is its frequency. Where counts were recorded bilaterally from the holotype, both counts are given and separated from each other by a slash; the first count presented is the left count.

Key to species of *Xenisthmus* in the Red Sea

- 1 Tongue rounded to truncate; posterior nostril with well-developed anterior flap; second dorsal-fin rays I,11–12, usually I,11; anal-fin rays I,10–11; ctenoid scales extend anteriorly on midside to below origin of second dorsal fin in specimens larger than about 15 mm SL (ctenoid scales mostly restricted to caudal peduncle in smaller specimens). *X. polyzonatus*
- Tongue indented; posterior nostril with raised rim, but without well-developed anterior flap; second dorsal-fin rays I,13–15; anal-fin rays I,12–14; ctenoid scales restricted to caudal peduncle or absent. 2
- 2 Five preopercular pores (pores MNOPQ); second dorsal-fin rays I,13–14, usually I,13; anal-fin rays I,12–13, usually I,12. *X. balius*
- Three preopercular pores (pores MNO); second dorsal-fin rays I,14–15, usually I,15; anal-fin rays I,13–14. *X. oligoporus* new species

***Xenisthmus oligoporus* new species**

Few-pored wriggler

Figures 1–3; Tables 1–2

Holotype. SMF 34908 (field number KAU13-20), 18.0 mm SL male, Red Sea, Saudi Arabia, Duba, unnamed island, fringing reef (27°04'N 35°46'E), 10–12 m, S.V. Bogorodsky, 19 March 2013.

Paratypes. BPBM 27446, 1: 25.0 mm SL female, Red Sea, Sudan, Towartit Reef, 10–13 m, J.E. Randall, 13 January 1980; KAUMM 006 (tissue sample KAU13-578), 1: 17.7 mm SL female, Red Sea, Saudi Arabia, Duba (26°57'N 35°57'E), small bay with reef wall with many small caves, 12 m, S.V. Bogorodsky, 20 June 2013; AMS I.47270-001 (field number F39), 1: 23.0 mm SL male (subsequently cleared and stained), Red Sea, Saudi Arabia, Farasan Archipelago (16°50' N 42°02' E), sand flat with coral patches, 6–8 m, S.V. Bogorodsky & T.J. Alpermann, 21 February 2012.

Diagnosis. *Xenisthmus oligoporus* is distinguished from congeners in having a reduced number of cephalic sensory pores (lacking pores A, I, J, K, P and Q) and in having 14–15 segmented rays in the second dorsal fin.



FIGURE 1. *Xenisthmus oligoporus*, new species, holotype, SMF 34908, 18.0 mm SL male, Duba, Saudi Arabia, Red Sea. Photograph by S.V. Bogorodsky.

Description. Dorsal-fin rays VI + I, 15 (I, 14 f1; I, 15 f2), all (all or all but first 2) segmented rays branched; first dorsal-fin pterygiophore formula 3-13110; anal-fin rays I, 13 (I, 13 f2; I, 14 f1), all (all or all but first) segmented rays branched; pectoral-fin rays 17/17 (17 f3; 18 f2), upper 2/1 (1–2) and lower 2 rays unbranched; pelvic-fin rays I, 5, inner ray unbranched; segmented caudal-fin rays 9 + 8; branched caudal-fin rays 7 + 6 (7); upper unsegmented caudal-fin rays 8 (7 f2; 8 f1); lower unsegmented caudal-fin rays 7 (6 f2; 7 f1); total caudal-fin rays 32 (30 f2; 32 f1); scales in lateral series 61/59 (58 f1; 59 f1; 61 f1; 63 f2; 64 f1); scales in transverse series counted anterodorsally from anal-fin origin 19/21 (18 f2; 19 f1; 20 f1; 21 f1; 22 f1); scales in transverse series counted posterodorsally from anal-fin origin 19/19 (18 f1; 19 f2; 20 f2; 22 f1); circumpeduncular scales 28 (29 f2; 30 f1); predorsal scales 17 (16 f1; 20 f1); gill rakers not determined for holotype (3 + 9 f1; 3 + 10 f1), rakers short, slender and fully ossified; pseudobranch filaments not determined for holotype (4 f1; 5 f1); vertebrae 10 + 16; epurals 2.

Morphometric data are summarised in Table 1.

Body covered with small, cycloid scales, except for caudal peduncle where scales mostly ctenoid; ventral contour of body fully scaled, except sometimes for narrow area beneath branchiostegal membranes; predorsal scales extending anteriorly to or slightly posterior to vertical through posterior edge of preopercle; cheeks partially (anteriorly only) to fully scaled; upper part of operculum scaled; cycloid scales present on pectoral-fin base; single row of ctenoid scales on fleshy portion of caudal-fin base; no scales on dorsal- or anal-fin bases.

Cephalic sensory pores B'C D(S)E'F'H' M'NO' (Figure 2); lower lip fleshy and protruding, with uninterrupted, free ventral margin; anterior nostril in short tube overhanging upper lip; posterior nostril with raised rim, but no membranous flap anteriorly; tongue indented anteriorly; gill opening extending anteriorly to point varying from about midway between verticals through posterior edge of preopercle and posterior edge of eye, to vertical through posterior edge of eye.

TABLE 1. Morphometric values for Red Sea *Xenisthmus* species, expressed as percentages of standard length (SL).

	<i>X. oligoporus</i> SMF 34908 (holotype)	<i>X. balius</i> KAUMM 006 (paratype)	AMS I.47270-001 (paratype)	<i>X. balius</i> Arabian Gulf (n = 9)	Red Sea (n = 11)	Red Sea (n = 7)	<i>X. polyzonatus</i>
SL (mm)	18.0	17.7	23.0	18.0–31.0	19.0–27.7	14.6–22.1	
Head length	27.2	27.7	26.5	21.3–24.6	20.7–23.5	22.7–28.4	
Predorsal length	36.7	35.6	33.9	31.0–34.4	30.5–33.0	32.7–35.6	
Prepelvic length	26.1	24.8	27.8	21.1–24.1	20.6–22.7	22.7–29.1	
Preadanal length	57.8	57.6	57.4	53.4–57.1	52.6–55.5	56.1–56.8	
D1 origin to D2 origin	17.2	17.5	18.7	18.3–20.7	18.3–20.7	16.2–19.2	
D2 base length	33.3	32.2	34.3	32.8–37.5	34.3–38.5	31.1–34.3	
A base length	28.3	26.6	26.7	27.1–30.9	28.6–32.6	25.3–30.3	
Pectoral base depth	6.7	8.5	7.0	6.8–7.9	5.8–7.6	7.3–9.0	
D1 origin to pelvic origin	16.1	15.3	15.2	15.9–17.8	14.7–17.4	16.4–19.1	
D2 origin to A origin	11.7	11.9	13.9	12.9–15.6	11.1–14.9	14.2–16.7	
Snout length	5.6	5.1	4.8	3.5–4.4	3.3–4.7	3.9–5.4	
Eye diameter	6.1	5.6	5.7	4.4–6.1	4.2–5.5	5.9–6.8	
Head width	14.4	15.8	17.4	12.9–14.8	11.2–13.2	12.3–17.6	
Body width	12.8	13.6	13.0	11.7–14.8	11.2–12.2	10.9–14.2	
Bony interorbital width	1.7	2.3	2.2	1.9–2.4	2.1–4.1	1.4–3.2	
Snout tip to retroarticular tip	10.0	10.2	11.3	9.1–9.9	8.5–10.1	9.5–11.8	
Caudal peduncle length	15.0	14.1	15.2	14.7–17.1	14.5–17.8	16.7–20.9	
Caudal peduncle depth	8.9	9.6	10.0	9.8–11.9	8.4–12.0	11.4–13.2	
D1 first spine	10.0	6.8	7.8	5.8–8.9	6.0–8.3	6.8–9.5	
D1 third spine	10.0	9.0	7.8	7.2–9.4	7.0–8.9	9.3–12.2	
D1 sixth spine	5.0	5.6	7.8	5.2–8.9	5.9–7.9	5.8–9.5	
D2 spine	8.9	7.3	9.1	7.4–9.1	6.6–8.9	7.9–10.3	
D2 first segmented ray	8.9	7.9	10.9	8.4–10.6	7.0–10.5	10.3–11.8	
D2 last segmented ray	11.1	10.2	13.0	8.2–12.3	7.0–11.4	10.1–13.1	
A spine	6.7	6.2	7.4	4.8–7.3	5.8–7.9	6.3–8.6	
A first segmented ray	8.3	6.2	8.3	7.1–10.0	7.6–9.2	7.9–12.2	
A last segmented ray	12.2	broken	12.2	9.4–12.1	6.4–12.6	10.1–14.5	
Pectoral length	21.2	20.3	24.7	15.8–21.1	17.7–20.5	15.9–23.0	
Pelvic spine	5.6	8.5	3.9	3.3–5.3	2.6–5.9	4.1–8.2	
Pelvic 4 th segmented ray	21.1	20.0	20.4	16.1–19.2	13.2–18.2	14.3–20.9	
Caudal fin	15.3	15.8	20.9	17.0–20.7	16.9–19.3	17.6–23.5	

TABLE 2. Frequencies distribution for selected meristic characters of Red Sea *Xenisthmus* species. * indicates characters for which bilateral counts are included.

	Segmented D2 rays										Segmented A rays										Pectoral rays*										Circumpeduncular scales									
	11	12	13	14	15	mean	10	11	12	13	14	mean	16	17	18	mean	27	28	29	30	31	32	33	34	35	36	37	mean												
<i>X. balius</i> (Arabian Gulf)	-	-	9	-	-	13.0	-	8	1	-	12.1	3	15	-	16.8	-	-	-	-	-	-	-	1	7	1	36.0														
<i>X. balius</i> (Red Sea)	-	-	11	2	-	13.2	-	-	11	2	-	12.2	10	14	1	16.6	-	-	4	1	3	1	2	1	-	1	32.3													
<i>X. oligoporus</i>	-	-	1	3	14.8	-	-	2	2	13.5	-	5	2	17.3	-	1	2	1	-	-	-	-	-	-	-	-	29.0													
<i>X. polyzonatus</i>	7	1	-	-	-	11.1	4	4	-	-	-	10.5	-	13	2	17.1	1	1	1	-	4	1	-	-	-	-	-	30.0												
Scales in lateral series*																																								
	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	mean																	
<i>X. balius</i> (Arabian Gulf)	-	-	-	-	-	-	1	2	2	3	2	4	2	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	64.2								
<i>X. balius</i> (Red Sea)	-	-	-	-	-	1	-	1	1	-	3	2	1	3	3	3	4	-	1	1	-	1	-	1	-	1	-	-	-	-	67.6									
<i>X. oligoporus</i>	-	-	-	-	1	2	-	2	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61.0										
<i>X. polyzonatus</i>	1	-	3	2	2	1	-	2	1	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59.2											
Scales in transverse series anterodorsally from A origin*																																								
	18	19	20	21	22	23	24	25	26	mean																														
<i>X. balius</i> (Arabian Gulf)	-	-	3	7	8	-	-	-	-	-	21.3	-	-	5	8	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21.0									
<i>X. balius</i> (Red Sea)	5	5	7	6	3	-	-	-	-	-	-	19.9	2	10	6	5	1	1	-	-	-	-	-	-	-	-	-	-	-	19.8										
<i>X. oligoporus</i>	2	2	1	2	1	-	-	-	-	-	-	-	1	4	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	19.5										
<i>X. polyzonatus</i>	-	-	3	2	2	4	-	3	1	22.6	-	-	3	4	5	-	2	-	1	21.9	-	-	-	-	-	-	-	-	-											

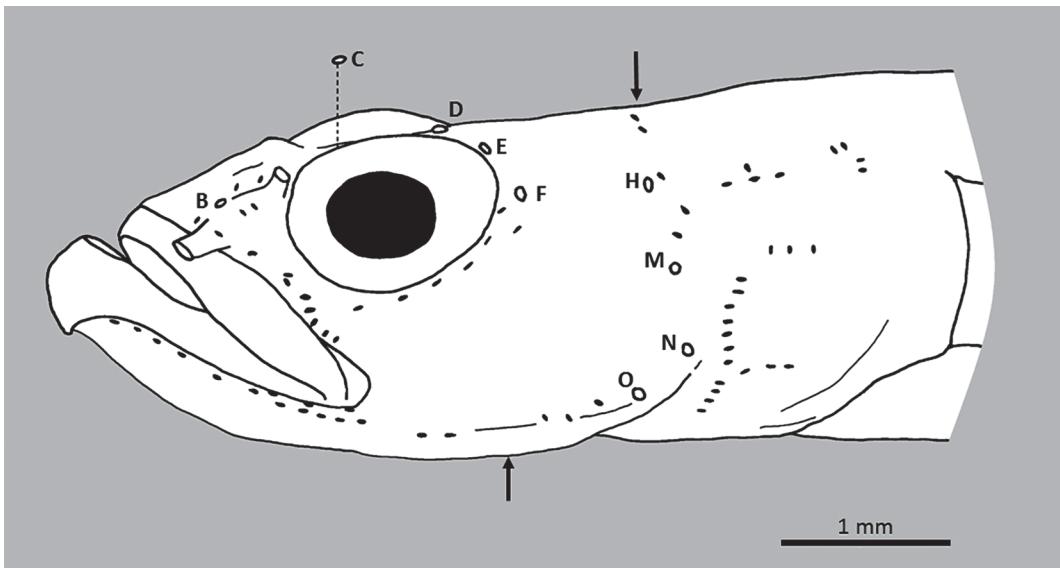


FIGURE 2. Right lateral view (reversed) of head of *Xenisthmus oligoporus*, new species, holotype, SMF 34908, 18.0 mm SL, showing distribution of superficial neuromasts (in black) and lateralis pores. Letter codes for lateralis pores follow Akihito *et al.* (1984); left components of paired pores and neuromasts not shown. Upper arrow indicates anterior extent of median predorsal scales; lower arrow indicates anterior extent of gill opening.

Upper jaw with three to four (anteriorly) or two (posteriorly) rows of small, conical teeth, the outer-row teeth largest and slightly curved; lower jaw with three to four (anteriorly) or two (posteriorly) rows of small, conical teeth, the outer-row teeth largest and slightly curved; vomer, palatines and tongue edentate.

Live coloration (based on photographs of the holotype and a paratype when freshly dead; Figure 1): head and body pale yellow to pale yellowish grey; short brown stripe extending from middle of upper lip through eye to above opercle, breaking into spots posteriorly; front of lower lip brown; upper part of operculum with small yellowish grey spots; iris yellowish brown to white above brown head stripe; upper part of pectoral-fin base narrowly yellowish grey to brown; sides and upper part of body with irregular dark yellow spots in four irregular longitudinal rows (each spot contains tiny dark brown spots), which form about twelve irregular X-shaped markings; first dorsal fin hyaline with a indistinct to distinct punctate brown spot on middle (anteriorly) to distal third (posteriorly) of each spine; second dorsal fin hyaline with brown spot on middle of each ray and anteriorly on adjacent fin membrane, and series of larger brown spots on or near the base of fin, these spaces about 2 to 3 rays apart and variably on ray bases or on membranes between rays; caudal fin hyaline with three curved bars of small brown to orange spots; caudal fin with a short black bar over middle few rays, the bar edged posteriorly with brown; second from lowermost ray on upper hypural plate with small black spot near base; anal, pelvic and pectoral fins hyaline.

Preserved coloration: similar to live coloration; brown and grey markings remain, but become less distinct.

Etymology. The specific epithet is from the Greek oligos (few) and poros (hole) and alludes to the relatively low number of sensory pores on the head. To be treated as a noun in apposition.

Habitat and distribution. Known from sandy areas adjacent to reefs in 6–13 m. The species is currently known from Duba, Saudi Arabia, south to the Farasan Archipelago (Figure 3).

Remarks. *Xenisthmus oligoporus* resembles *X. balius* and *X. chi* in having relatively high numbers of dorsal- and anal-fin rays, a similar colour pattern (body with reticulated mottling forming x-shaped markings on the body, caudal fin with a short dark basal bar and small dark spot on the fin) and in lacking a well-developed flap on the posterior nostril. It differs from each of these species in having reduced head pores (lacking pores A, I, J, K, P and Q), in having more segmented rays in the second dorsal fin (15 versus 13–14, usually 13 in *X. balius*, and 12 in *X. chi*) and in having more segmented anal-fin rays (13–14 versus 12–13, usually 12 in *X. balius*, and 11 in *X. chi*). It further differs from *X. chi* in having the predorsal scales extend anteriorly only to the vertical through the preopercle (versus with median series extending anteriorly to near pore D) and less extensive coverage of ctenoid scales (restricted to caudal peduncle versus covering body behind mid abdomen). In addition, it differs from *X. balius* in having fewer circumpeduncular scales (28–30 versus 30–37).

Xenisthmus oligoporus might be confused with *X. chapmani*, known only from the holotype from Vanuatu, but differs in having more pectoral fin rays (17-18 versus 15), no well-developed flap on the posterior nostril (versus flap present), fewer vertebrae (10 + 16 versus 10 + 17) and a different first dorsal-fin pterygiophore formula (3-13110 versus 3-12210).

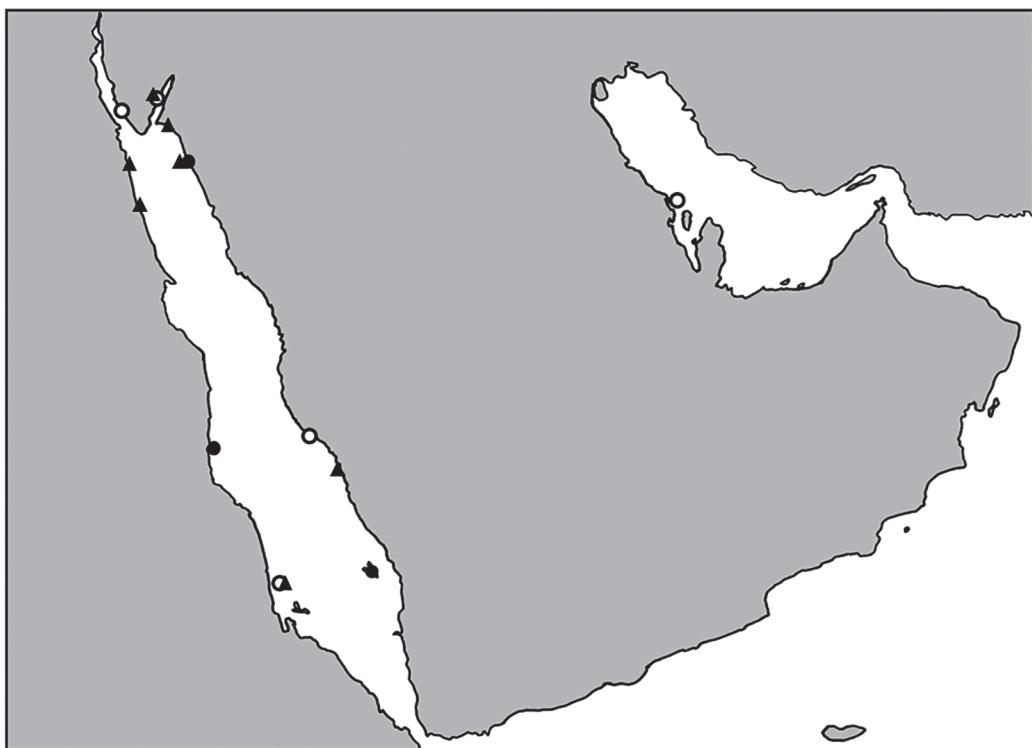


FIGURE 3. Distribution records for *Xenisthmus oligoporus* (closed circles), *X. balius* (open circles) and Red Sea *X. polyonotus* (triangles).

Xenisthmus balius Gill & Randall, 1994

Freckled wriggler

Figures 3-4; Tables 1-2

Xenisthmus balius Gill & Randall 1994: 446, figs 1-3 (type locality, northeast side of Jana Island, Saudi Arabia, Arabian Gulf; holotype BPBM 30458); Randall 1995: 345 (compilation; colour fig.); Carpenter *et al.* 1997: 215 (compilation; illustration).

Diagnosis. A species of *Xenisthmus* with the following combination of characters: dorsal-fin rays VI + I,13 (rarely I,14); anterior rim of posterior nostril raised, without well-developed flap; scales of body mainly cycloid; head and body pale, with reticulate mottling dorsally.

Description (data for Red Sea specimens given first, followed where different by Arabian Gulf specimens in parentheses). Dorsal-fin rays VI + I,13-14 (I,13), all or all but first segmented rays branched; first dorsal-fin pterygiophore formula 3-22110; anal-fin rays I,12-13, all but first 1-2 segmented rays branched; pectoral-fin rays 16-18 (16-17), upper 1-2 and lower 1-2 rays unbranched; pelvic-fin rays I,5, inner ray unbranched; segmented caudal-fin rays 9 + 8; branched caudal-fin rays 7-8 + 6-7 (6-8 + 6-7); upper unsegmented caudal-fin rays 7-9; lower unsegmented caudal-fin rays 6-8 (7-9); total caudal-fin rays 30-34 (31-35); scales in lateral series 59-75 (60-70); scales in transverse series counted anterodorsally from anal-fin origin 18-22 (20-22); scales in transverse series counted posterodorsally from anal-fin origin 18-23 (20-22); circumpeduncular scales 30-37 (35-37); predorsal scales 12-20 (16-20); gill rakers 3-4 + 8-12 = 11-16; pseudobranch filaments 4-5; vertebrae 10 + 16; epurals 2.

Morphometric data are given in Table 1.

Body covered with small, cycloid scales, except for caudal peduncle, with either no or a few, irregularly distributed ctenoid scales (Arabian Gulf specimens) or mostly ctenoid scales (Red Sea specimens); ventral contour of body fully scaled, except for narrow area beneath branchiostegal membranes; predorsal scales extending anteriorly to or slightly posterior to vertical through posterior edge of preopercle; usually no scales on operculum or cheek (only one Red Sea specimen with a few imbedded scales on cheek); cycloid scales present on pectoral-fin base; narrow band of scales on fleshy portion of caudal-fin base, these usually cycloid, but sometimes with several, irregularly distributed ctenoid scales; no scales on dorsal- or anal-fin bases.

Head pores A'BC D(S)EFHIJK' M'NOPQ' (see Gill & Randall 1994, fig. 2; two Red Sea specimens have additional pore in J position on one side only); lower lip fleshy and protruding, with uninterrupted, free ventral margin; anterior nostril in short tube; posterior nostril with raised rim, without prominent membranous flap anteriorly, though sometimes with small irregular flap; tongue weakly indented anteriorly; gill opening extending anteriorly to about midway between verticals through posterior edge of preopercle and posterior edge of eye.

Upper jaw with two or three (anteriorly) or two (posteriorly) rows of small, conical teeth, the outer-row teeth largest and slightly curved; lower jaw with three (anteriorly) or two (posteriorly) rows of small, conical teeth, the outer-row teeth largest and slightly curved; vomer, palatines and tongue edentate.



FIGURE 4. *Xenisthmus balius*, SMF 35837, 22.0 mm SL female, Al Lith, Saudi Arabia. Photograph by S.V. Bogorodsky.

Live coloration (based on photographs of specimens from the Arabian Gulf and the Red Sea; Figure 4): head and body pale pinkish brown to pale grey, paler ventrally, with irregular, reticulate, brown to black mottling, this darkest on mid-side, forming about 10–12 spots or x-shaped markings laterally; four short, brown to dark grey bars extending from eye, one from mid-anterior part of orbital rim to mid-side of upper lip, one from below mid-ventral part of orbital rim to behind posterior edge of maxilla, one from midposterior part of orbital rim to upper part of preopercle, and one from behind eye to upper part of pectoral-fin base; mid-side of lower lip and adjacent inner part of lower jaw brown to dark brown to dark grey; iris silvery to bluish white or orange-brown, with a dark reddish brown spot at 12, 3, 6 and 9 0' clock positions; upper part of pectoral-fin base with irregular brown to dark grey spot beneath and immediately behind operculum, sometimes with additional spot on ventral part of fin, and more-posterior, smaller spot near bases of upper few rays; interspaces between mottling and spots on head and body sometimes with irregular patches of bright white; short dark brown to black bar on caudal-fin base; first dorsal fin hyaline with brown to dark grey spots on middle of all or most spines, sometimes with additional spots distally; second dorsal fin hyaline with dark grey spots between bases of each ray, a dark grey spot on middle of each ray, and an additional one or two rows of spots on each ray (spots often displaced onto fin membranes); anal fin hyaline, sometimes with dark grey spots between ray bases and on middle of each ray; caudal fin hyaline usually with one (rarely two), irregular, dark grey-brown to black spots on bases of lowermost two rays on upper hypural plate, little posterior to bar at level of its upper half; area between spot(s) and dark bar on caudal-fin base white to

yellowish white; caudal fin with a few small dark grey spots arranged in slightly concave or reticulate columns on remainder of fin; pectoral fins hyaline, with irregular dark grey spot basally on upper half of fin, sometimes with additional cluster on ventral half of fin; pelvic fins hyaline.

Preserved coloration: similar to live coloration; dark markings remain, becoming pale greyish brown to dark grey-brown.

Habitat and distribution. *Xenisthmus balius* was previously known only from Jana Island, Saudi Arabia, in the Arabian Gulf. We newly record this species from the Red Sea on the basis of 13 specimens collected in Eritrea, Egypt and Saudi Arabia (Figure 3). It has been collected from sandy areas adjacent to coral rubble and reefs in 1.5–17 m.

Remarks. The Red Sea specimens agree in all salient details with the nine type specimens from the Arabian Gulf, but extend our understanding of variation in the following meristic characters (see Description above and Table 2): second dorsal-fin rays; pectoral-fin rays; lower unsegmented caudal-fin rays; scales in lateral series; scales in transverse series counted anterodorsally from anal-fin origin; scales in transverse series counted posterodorsally from anal-fin origin; circumpeduncular scales; and predorsal scales. The new specimens also extend known variation in the following morphometric characters (Table 1): head length; predorsal length; preanal length; second dorsal-fin base length; anal-fin base length; first dorsal-fin origin to pelvic-fin origin; second dorsal-fin origin to anal-fin origin; snout length; orbit diameter; head width; body width; bony interorbital width; snout tip to retroarticular tip; caudal peduncle length; caudal peduncle depth; length of third spine of first dorsal fin; length of spine of second dorsal fin; length of first segmented ray of second dorsal fin; length of last segmented ray of second dorsal fin; anal-fin spine length; length of last segmented anal-fin ray; pelvic-fin spine length; fourth segmented pelvic-fin ray length; caudal-fin length.

Gill & Randall (1994) noted that ctenoid scales were present in only a few of the Arabian Gulf specimens, where they were just a few irregularly distributed ctenoid scales on the caudal peduncle and caudal-fin base. Ctenoid scales are present in all of the Red Sea specimens, and tend to be more widely distributed on the caudal peduncle. Gill & Randall also noted that the type specimens lack cheek scales, whereas one of the Red Sea specimens has a few imbedded scales on the anterior part of the cheek.

Material examined. RED SEA. **Egypt:** USNM 270676, 1: 27.7 mm SL male, Gulf of Suez, El Tor, 0–9 m, rotenone, V.G. Springer *et al.*, 27 September 1969; USNM 270673, 4: 19.0–24.6 mm SL males, 4: 21.1–22.8 mm SL females, Gulf of Aqaba, just N of Ras Burqa, to 1.8 m (stated depth to 6 feet), rotenone, V.G. Springer, 5 September 1969 (field number VGS 69–21). **Eritrea:** USNM 270672, 2: 23.0–24.2 mm SL females, S shore of Difnein Island (16°36'N 39°20'E), 0–4 m, V.G. Springer *et al.*, 15 August 1969 (field number VGS 69–15). **Saudi Arabia:** SMF 35837 (tissue sample KAU11-225), 1: 22.0 mm SL female, Al Lith, fringing reef, 10 m, S.V. Bogorodsky, 29 March 2011; KAUMM 417, 1: 17.6 mm SL female, Saudi Arabia, Al Lith, fringing reef, 6–8 m, S.V. Bogorodsky & T.J. Alpermann, 7 March 2012 (field number AL3). ARABIAN GULF. **Saudi Arabia:** BPBM 30458, 1: 25.5 mm SL female (holotype), NE side of Jana Island, base of dropoff in 15 m, J.E. Randall, A.B. Tarr & J.E. Burfhard, 15 June 1984; BPBM 33308, 1: 26.4 mm SL male (paratype), 1: 29.0 mm SL female (paratype), W side of Jana Island, reef flat, sand and rubble with small patches of mostly dead coral, 1.5 m, J.E. Randall, L.J. McCarthy, B.E. Stanaland & A.B. Tarr, 13 September 1985; AMNH 97301, 1: 29.4 mm SL female (paratype), AMS I.34236-001, 1: 23.2 mm SL male (paratype), BMNH 1993.9.25:1, 1: 19.1 mm SL male (paratype), BPBM 33353, 3: 18.0–31.0 mm SL females (paratypes), USNM 326758, 1: 26.1 mm SL male (paratype; subsequently cleared and stained), SE side of Jana Island, base of drop-off in 17 m, J.E. Randall, L.J. McCarthy, B.E. Stanaland & A.B. Tarr, 13 September 1985.

Xenisthmus polyzonatus (Klunzinger, 1871)

Bullseye wriggler

Figures 3, 5; Tables 1–2

Eleotris polyzonatus Klunzinger 1871: 482 (type locality, Al-Qusair, Red Sea Governorate, Egypt, Red Sea; two syntypes ZMB 8018).

Xenisthmus polyzonatus; Clark 1968: 5, 7 (key; Ghardaqa, Egypt); Dor 1984: 88 (list); Goren & Dor 1994: 67 (list); Golani & Bogorodsky 2010: 50 (list).

Diagnosis. A species of *Xenisthmus* with the following combination of characters: second dorsal-fin rays usually I,11 (rarely I,12); anal-fin rays I,10–11; tongue rounded to truncate; and posterior nostril with well-developed anterior flap.

Description (based on eight Red Sea specimens, 13.4–22.1 mm SL). Dorsal-fin rays VI + I,11–12, all segmented rays branched; first dorsal-fin pterygiophore formula 3-22110; anal-fin rays I,10–11, all segmented rays branched; pectoral-fin rays 17–18, upper 1–2 and lower 1–2 rays unbranched; pelvic-fin rays I,5, inner ray unbranched; segmented caudal-fin rays 9 + 8; branched caudal-fin rays 6–8 + 6–7; upper unsegmented caudal-fin rays 6–8; lower unsegmented caudal-fin rays 6–8; total caudal-fin rays 29–32; scales in lateral series 54–66; scales in transverse series counted anterodorsally from anal-fin origin 20–26; scales in transverse series counted posterodorsally from anal-fin origin 20–26; circumpeduncular scales 27–32; predorsal scales 17–20; gill rakers 3–4 + 9–10 = 12–14; pseudobranch filaments 4; vertebrae 10 + 16; epurals 2.

Morphometric data are given in Table 1.

Body covered with small, cycloid scales anteriorly, and ctenoid scales posteriorly, the anteriormost ctenoid scales on midside more-or-less below origin of second dorsal fin in specimens larger than about 15 mm SL (ctenoid scales mostly restricted to caudal peduncle in smaller specimens); ventral contour of body fully scaled, except for narrow area beneath branchiostegal membranes; predorsal scales extending anteriorly to or slightly posterior to vertical through posterior edge of preopercle, sometimes with 1–2 additional median scales anterior to main scales; operculum scaled at least dorsally, sometimes with scales covering most of opercle; cheek with at least some scales, often fully scaled; cycloid scales present on pectoral-fin base; narrow band of scales on fleshy portion of caudal-fin base, these usually cycloid, but sometimes with several, irregularly distributed ctenoid scales; no scales on dorsal- or anal-fin bases.

Head pores A'BC D(S)EFHIJK' M'NOPQ' (head pores incompletely developed in some specimens smaller than 15 mm SL); lower lip fleshy and protruding, with uninterrupted, free ventral margin; anterior nostril in short tube; posterior nostril with raised rim, with prominent membranous flap anteriorly; tongue rounded to truncate anteriorly; gill opening extending anteriorly to about midway between verticals through posterior edge of preopercle and posterior edge of eye.

Upper jaw with 2–3 (anteriorly) or 2 (posteriorly) rows of small, conical teeth, the outer-row teeth largest and slightly curved; lower jaw with 3 (anteriorly) or 2 (posteriorly) rows of small, conical teeth, the outer-row teeth largest and slightly curved; vomer, palatines and tongue edentate.

Live coloration (based on live and freshly dead specimens from the Red Sea; Figure 5): head and body pale greenish grey to olive, becoming pale pink to white on lower head and abdomen; four short, reddish brown to dark grey-brown bars extending from eye, one from mid-anterior part of orbital rim to mid-side of upper lip, one from below mid-ventral part of orbital rim to behind posterior edge of maxilla, one from midposterior part of orbital rim to mid-upper part of preopercle, and one from behind eye to upper part of pectoral-fin base; mid-side of lower lip and adjacent inner part of lower jaw reddish brown to dark grey-brown; upper and sometime anterior part of operculum with irregular reddish brown to dark grey-brown markings; iris mottled reddish brown to grey-brown; upper half of body with 12–13 reddish brown to dark olive-brown slightly oblique bars, the first passing just anterior to pectoral-fin base and the last just anterior to caudal-fin base; area between bars sometimes with indistinct white spots or bars; upper part of pectoral-fin base with irregular reddish brown to dark grey-brown spot, with second spot on mid-ventral part of fin base; first dorsal fin hyaline with two rows of reddish brown to dark grey spots on each spine, one along base of fin and the other through middle of fin; second dorsal fin and anal fin hyaline with one (anteriorly) to three (posteriorly) curving rows of dark spots along each fin ray; caudal fin hyaline with large (almost eye-sized) black spot near middle of fin base, rimmed anteriorly by narrow yellow to white curved bar and preceded by broader orange to reddish brown or grey arc-like bar; remainder of caudal fin with 5–6 convex (anteriorly) to vertical (posteriorly) reddish brown bars; pectoral fins hyaline, white basally, with two large orange-brown to grey-brown spots, one near base of mid-upper rays and the other near base of mid-lower rays; pelvic fins pale pink to white.

Preserved coloration: similar to live coloration; dark markings remain, becoming pale greyish brown to dark grey-brown.

Habitat and distribution. *Xenisthmus polyzonatus* is currently regarded as a widespread species, ranging from the Red Sea and East Africa to French Polynesia, with *Luzoneleotris nasagbua* Herre (1938; type locality Nusagbua, Luzon, Philippines) considered a synonym. However, detailed comparison of specimens from

throughout this range has not been completed (currently underway by the first author), and it is possible that there is a complex of closely related species involved. Preliminary molecular analyses also showed that specimens from the western Pacific identified as *X. polyzonatus* represent distinct lineages. We therefore restrict our treatment of the species to specimens from the Red Sea, where it is widely distributed (Figure 3). It typically inhabits crevices close to the base of fringing reefs in the depth range of 1.5–16 m.



FIGURE 5. *Xenisthmus polyzonatus*, **A**: uncatalogued, 36.0 mm SL, Mangrove Bay, El Quseir, Egypt, Red Sea; **B**: SMF 35838, 14.8 mm SL juvenile, Duba, Saudi Arabia, Red Sea. Photographs by S.V. Bogorodsky.

Remarks. Clark (1968) reported on a 40 mm SL specimen of *X. polyzonatus* from Ghardaqa (= Hurghada), Egypt. Details given in her key indicate the specimen was correctly identified to the present species, but the size is large for the species. Although our examined Red Sea specimens do not exceed size 22.1 mm SL, an uncatalogued specimen from El Quseir measured 36.0 mm SL (Figure 3A). Clark's specimen (deposited in the Marine Biological Station at Hurghada), was not examined by us.

Material examined. **RED SEA. Egypt:** USNM 270680, 1: 22.0 mm SL male, ca. 1 mile N of Ras Burqa, 0–7.5 m, V.G. Springer *et al.*, 21 July 1969. **Eritrea:** USNM 270677, 1: 20.3 mm SL female, 1: 21.5 mm SL male, S shore of Difnein I., 16°36'N 039°20'E, 0–4 m, V.G. Springer *et al.*, 15 August 1969; USNM 270681, 1: 18.9 mm SL female, collected with USNM 270677. **Saudi Arabia:** KAUMM 419 (field number KAU13-34), 1: 14.6 mm SL juvenile, Al Khoreybah, st 38, unnamed island, seaward reef, corals at base of fringing reef, 8–12 m, S.V. Bogorodsky, 23 June 2014; SMF 35839 (tissue sample KAU11-291), 1: 22.1 mm SL male, Al Qunfudhah, reef flat, 1.5 m, S.V. Bogorodsky & T.J. Alpermann, 30 March 2011; KAUMM 418 (field number KAU13-29), 1: 13.4 mm SL juvenile, st 31, Duba, bay with coral wall, 12–16 m, S.V. Bogorodsky, 21 June 2013; SMF 35838 (field number KAU13-21), 1: 14.8 mm SL juvenile, st 24, Duba, base of fringing reef, 10–12 m, S.V. Bogorodsky, 19 March 2013.

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